GUIDE TO USING THE MONTANA DEPARTMENT OF AGRICULTURE ROTATION MODELING SPREADSHEET

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Disclaimer:
The Montana Department of Agriculture and its staff are not responsible for:

- Decisions made by parties as a result of using of this spreadsheet or the outcome of those decisions,
- errors within the spreadsheet,
- the reasonableness of original estimates and sample rotations contained in the spreadsheet, or
- the outcome of decisions made by parties who use the spreadsheet as a decision tool after making alterations to the spreadsheet.

The Montana Department of Agriculture made considerable efforts in designing and testing the spreadsheet, and measures were taken to prevent accidental alteration of formulas. Spreadsheet users should adjust the assumptions and rotation information to be applicable to their farm and check for errors before making any decisions. Ultimately, spreadsheet users are responsible for their own decisions. Spreadsheet users should avoid changing formulas, but if it is necessary to change formulas, take extreme caution.

Purpose

The Montana Department of Agriculture created the rotation modeling spreadsheet to serve as a tool for farmers to compare the economics of different crop rotations and farming systems (organic/conventional). The spreadsheet allows users to design and compare up to four organic rotations and four conventional rotations. The duration of the rotations can be up to 15 years long. For each crop/year, the user selects field operations to be performed. Up to 15 field operations can be entered for each crop/year. Selected field operations are used to calculate fuel and lubrication costs and to determine time/labor requirements for comparison and planning purposes. Spreadsheet users can use this information to consider the impacts of operations on moisture and to consider equipment needs as it pertains to the timing and synchronization of field operations.

An effort was made to develop reasonable estimates entered into input variables (yellow cells). *(See Documentation of Original Estimates Entered in Assumptions Worksheet)* However the original estimates are generalized and were developed at a point in time approximating conditions for Fall 2007, when markets were strong, but prior to drastic market price increases. The default yield assumptions were based on averages from historic yields over an eleven-year period for a group of three counties (McCone, Phillips, and Valley counties). Users can *(and should)* change these assumptions and estimates to make the spreadsheet calculations applicable to their farm and growing conditions and to reflect their expectations for future years.

General Instructions:

When using the spreadsheet, only modify or enter information in cells with a yellow background in the following worksheets: Assumptions; Organic Rotation 1 – Organic Rotation 4; and Conventional Rotation 1 – Conventional Rotation 4.

Information has already been entered in the yellow spreadsheet cells based on crop and input price levels that existed in early Fall 2007. The information entered is derived from a number of sources *(See Documentation of Original Estimates Entered in Assumptions Worksheet)*. This information can *(and should)* be changed to match the production history and conditions of the farm being evaluated. Spreadsheet users should consider whether the default values reflect their expectations for the future.

It is recommended that users work through the spreadsheet in the order of the worksheets. The Assumptions Worksheet is centralized location where assumptions for price, yield, and costs are entered for a wide range of crops on a per-acre basis. The Organic and Conventional Rotation Worksheets (Rotation Worksheets) are where the spreadsheet user designs individual rotations. Information can be entered for up to four organic and four conventional rotations. When a crop is selected for a year in the rotation, the spreadsheet uses information from the Assumptions Worksheet to calculate revenue and expenses. The Rotation Worksheets are designed with some flexibility to allow spreadsheet users to add some expenses that may be specific to the farm, crop, or field for each individual year in the rotation. For example, if raising a particular crop requires the farm to rent an implement or hire a custom operator to complete a field operation, the cost can be entered on a $/acre basis. The Rotation Worksheets also allow spreadsheet users to specify the field operations that will be performed in individual years. The spreadsheet uses this information to calculate the fuel cost and direct labor requirements for field work (hours/acre). The charts that follow the Rotation Worksheets display and compare the results of calculations made in each Rotation Worksheet.

Yellow Spreadsheet Cells

Information should be entered or changed only in spreadsheet cells with a yellow background. The yellow spreadsheet cells are for variables. The spreadsheet performs calculations in other cells, based on the entries in the yellow cells. Altering cells with a white background will change formulas, which will likely cause calculations to be in error, significantly impacting analysis results.

Many of the spreadsheet cells that contain formulas have a white background and are "locked". Additionally, some cells and worksheets are hidden to help prevent accidental changes to formulas and avoid confusing spreadsheet users. If the user finds it necessary to change or unhide cells, the individual sheet must be unlocked using the following menu sequence: Tools – Protection – Unprotect Sheet – password = "password". To look for hidden cells, look at the row number for gaps, highlight the rows on either side of the gap, right click, and choose Unhide. To look for hidden sheets: Format – Sheets – Unhide – select sheet to unhide.

Drop-down Boxes

Drop-down boxes are used to restrict the entries that can be made in the Rotation Worksheets (Organic Rotation 1 – Organic Rotation 4, and Conventional Rotation 1 – Conventional Rotation 4). Drop-down boxes are also used in the Rotation Worksheets to restrict:

- selection of crops for each year in the rotation
- selection of field operations for each year in the rotation
- selection of method of crop management in the Organic Rotation Worksheets (conventional, transitional, and organic)

All drop-down boxes have the option to select a blank entry if no selection is desired; the only way to select a blank entry is by using the drop-down box. If the Rotation Worksheet has information entered into more years than is desired for a rotation, blank entries should be selected for that year's crop, field operations, and crop management method (organic rotations only).

Navigating the Spreadsheet:

WORKSHEETS *(in order)*	**EXPLANATION & INSTRUCTIONS**
Disclaimer	Liability disclaimer
Assumptions	The majority of adjustable spreadsheet variables are located in the Assumptions Worksheet (yellow spreadsheet cells). Adjustable variables exist for organic and conventional farming systems, crop, commodity market price, yield, seed cost, herbicide cost, fungicide cost, insecticide cost, crop insurance cost, fertilizer application rate and cost, fuel and lubrication cost, field operation fuel consumption, off-farm commodity trucking cost, organic assessment cost, operating interest cost, net present value discount rate, and machinery capacity (for field operation time requirements).
Organic Rotation 1 Organic Rotation 2 Organic Rotation 3 Organic Rotation 4	These worksheets allow users to design up to four organic rotations. In each worksheet: • Use drop-down boxes to select the crop management style (blank, conventional, transitional, organic). Select blank entries for years not under consideration. • Use drop-down boxes to select the crop to be grown each year to establish the sequence of the rotation (up to 15 years in length). Select blank entries for years not under consideration. It is recommended that users enter crops for the transition and first complete rotation that will be certified organic. • Use drop-down boxes to select the field operations to be performed for each crop/year in the rotation (up to 15 operations per crop/year). Select "blank" for years not under consideration. • The yield adjustment factor increases or decreases the yield of a particular year (*relative to the yield entered in the Assumptions page for a given crop*) to allow spreadsheet users to adjust for yield improvements that occur with time following the transition to organic. The yield adjustment factor also allows adjustments to be made to reflect rotational benefits. Examples of how this works: a yield adjustment factor of 100% results in no change, 200% doubles the yield, 50% reduces the yield by half.

Navigating the Spreadsheet:

WORKSHEETS *(in order)*	**EXPLANATION & INSTRUCTIONS**
Organic Rotation 1 Organic Rotation 2 Organic Rotation 3 Organic Rotation 4	***(Continued)*** • Adjustable variables Land Rent, Custom Hire (Contracted Field Operations), Machine Rent, Direct Labor, and Other Direct Costs allow spreadsheet users to enter additional direct costs that may apply to the crop/year. For purposes of comparison, these costs are relevant only if there is a difference in these costs between methods of farming (organic vs. conventional), crops, or years. • The yield, commodity price, direct expenses, and return after direct expenses are shown for each crop/year in the rotation. • Commodity prices for the transition period are set to equal conventional commodity prices. • Crop yields for the transition period are set to equal organic commodity yields. Rotation Summary Calculations: • Number of years for Conventional, Transitional, Organic crop management entered (each) • Average annual return after direct costs for all years of the rotation; • Average annual return after direct costs for years certified organic; • Average annual return after direct costs during transition years • Net present value of the annual return after direct costs for Year 1 – Year 3 and for Year 1 – Year 4. • Direct labor requirements for field operations (hours/acre) for each crop/year.

Conventional Rotation 1
Conventional Rotation 2
Conventional Rotation 3
Conventional Rotation 4
	These worksheets allow users to design up to four conventional rotations.
	
	In each worksheet:
	• Use drop-down boxes to select the crop to be grown each year to establish the sequence of the rotation (up to 15 years in length). Select blank entries for years not under consideration.
	    o Enter crops for at least four years so that net present value of Year 1 – Year 4 calculates correctly (*so in the case of continuous cropping of wheat, wheat would be entered in Year 1, Year 2, Year 3, and Year 4*).
	    o Enter information so that cycles of a rotation are complete. (*For example, if the rotation is wheat – fallow, the following should be entered to accomplish the objectives of presenting full and balanced rotations and entering crops for a minimum of four years: Yr1 – Wheat, Yr2 – Fallow, Yr3 – Wheat, Yr4 – Fallow*).
	• Use drop-down boxes to select the field operations to be performed for each year in the rotation (up to 15 operations per crop/year). Select blank entries for years not under consideration.

Navigating the Spreadsheet:

<table>
<tr><th>WORKSHEETS (in order)</th><th>EXPLANATION & INSTRUCTIONS</th></tr>
<tr><td>Conventional Rotation 1
Conventional Rotation 2
Conventional Rotation 3
Conventional Rotation 4</td><td>Continued

The yield adjustment factor increases or decreases the yield of a particular year (relative to the yield entered in the Assumptions page for a given crop) to allow spreadsheet users to make adjustments to reflect rotational benefits. Examples of how this works: a yield adjustment factor of 100% results in no change, 200% doubles the yield, 50% reduces the yield by half.
Adjustable variables Land Rent, Custom Hire (Contracted Field Operations), Machine Rent, Direct Labor, and Other Direct Costs allow spreadsheet users to enter additional direct costs that may apply to the crop/year. For purposes of comparison, these costs only matter if there is a difference in these costs between methods of farming (organic vs. conventional), crops, or years.
The spreadsheet calculates a legume crop fertilizer credit in the year peas or lentils are grown, when peas are plowed down, and in the last year of an alfalfa stand. The amount of credit is based on the value of the nitrogen fixed. The legume crop fertilizer credit appears in the spreadsheet as a “negative expense” (income). As such, this is a non-cash benefit that is not realized in the year presented, but is attributed to the legume crop. If spreadsheet users want this credit to be $0, the credit amounts (lbs/acre) should be set to zero in the Assumptions Worksheet.
The yield, commodity price, direct costs, and return (after direct costs) are shown for each crop/year in the rotation.

Rotation Summary Calculations:

Average annual return after direct costs for the rotation.
Net present value of the annual return after direct costs for Year 1 – Year 3 and for Year 1 – Year 4.
Direct labor requirements for field operations (hours/acre) for each crop/year.
</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Rotation Summary</td><td>Summarizes the average annual returns (after direct costs) and net present value of Year 1 – Year 3 for organic and conventional rotations. Lists the crop sequence designed for each rotation.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>NPV Yr1 – Yr 3
NPV Yr1 – Yr 4
(short-term comparison)</td><td>
Chart that compares the net present value of the annual return after direct costs for Year 1 – Year 3 of all organic and conventional rotations.
Chart that compares the net present value of the annual return after direct costs for Year 1 – Year 4 of all organic and conventional rotations.
</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Trans Through First Rotation
(a mid-term comparison)</td><td>Chart that compares:

Organic rotations’ average annual return after direct costs for all years in the rotation designed by the user
Conventional rotations’ average annual return after direct costs
</td></tr>
</table>

Navigating the Spreadsheet:

WORKSHEETS *(in order)*	**EXPLANATION & INSTRUCTIONS**
Comparison After Certification *(long-term perspective – after certification is achieved)*	Chart that compares: • Average annual return after direct costs for years in which the crop is certified organic in the rotation designed by the user • Conventional rotations' average annual return after direct costs
Organic Rotation Charts *(annual return after direct costs)*	Chart that shows the annual return after direct costs for each crop/year of each organic rotation. The following summary information is also presented for each presentation: net present value of annual return after direct costs for Year 1 – Year 3 and Year 1 – Year 4, and average annual return after direct costs is presented for all years, years in which production is certified organic, and transition years.
Conventional Rotation Charts *(annual return after direct costs)*	Chart that shows the annual return after direct costs for each crop/year of each conventional rotation. The following summary information is also presented for each rotation: net present value of Year 1 – Year 3, net present value of Year 1 – Year 4, and average annual return after direct costs.

Key Comparisons

- Comparisons of Average Annual Return After Direct Costs: In charts that make comparisons, conventional rotations are represented the same in each chart: average annual return after direct costs for the conventional rotation that is designed.
- There are various ways of comparing the returns of organic rotations and conventional rotations.
    - Average Annual Return After Direct Costs – All Years ($/acre): For a mid-term comparison of average annual returns, this is the best measure to use because it compares the period of transition and first rotation that is certified organic (*if the rotations are set up properly to allow for true comparisons*). This measure can be used to compare organic rotations to each other and to compare organic rotations to conventional rotations. For organic rotations, this compares the average annual return after direct costs for all years, including the transition *(or even years that conventional management is used in the case of a very complex rotation).*
    - Average Annual Return After Direct Costs – Organic ($/acre): For organic rotations this compares the average annual return after direct costs for years in which certified organic production occurs, making this the best measure to compare organic rotations following the transition period. This comparison is best for comparing organic rotations to conventional rotations from a long term perspective (after transition is complete).
        - If a complex organic rotation is designed that includes years of conventional management, the results of this calculation for that particular organic rotation should be ignored, and the Average Annual Return After Direct Costs - All Years should be used instead for comparison purposes.
    - Average Annual Return After Direct Costs – Transition ($/acre): This is a good measure for comparison of the decision to convert to organic production in the short-term, in the early years of transitioning a field or farm to certified organic production. This can be used to compare the economics of different transition

strategies and to help determine the opportunity cost (if any) of transitioning to organic. Keep in mind that this measure only averages years in which "Transitional" is selected as the crop management style in the organic rotation sheets. Depending on field history, the transition period could be 0 – 3 years. To be certified, no prohibited substances can be applied 36 months prior to harvest.

- Net Present Value Year 1 – Year 3: For both organic and conventional rotations, this calculates the net present value of the first three years' return after direct costs. This measure utilizes the concept of the time value of money for determining the opportunity cost of converting to organic since the transition period will occur within the first three years. A weakness in the comparison is that circumstances exist in which transition is achieved in less than three years. Nonetheless, this is a good measure for comparing short-term economics of transitioning to organic to the economics of conventional practices.
- Net Present Value Year 1 – Year 4: For both organic and conventional rotations, this calculates the net present value of the first four years' return after direct costs. In order for comparisons to be valid, at least four years of information be entered into each rotation. Warning: in order for the calculations of the average annual return after direct costs (discussed previously) to be comparable, complete rotations should be entered, which may require that information be entered in rotations beyond Year 4. The calculation of the net present value for the first four years helps evaluate the opportunity cost of transitioning to organic, but provides a slightly longer period of review *(than the net present value of the first three years)* to account for differences in sequences of fallowing land and speed of achieving organic certification.
    - Net present value calculations for longer periods of time will provide useful information to compare the mid-term economic performance of different rotations and transition strategies, but for the calculations to be comparable, the same number of years must be compared. The spreadsheet's designer chose not to create a net present value for a longer period to avoid making the spreadsheet less flexible and harder to use. Spreadsheet users who understand what is required to maintain comparability are encouraged to set up net present value calculation for longer periods of time.
- Users can copy information from the crop rotation sheets and paste it into other spreadsheets (*use Paste Special – Values*) to simulate the economics of individual fields within a farm and build a model or plan for transitioning the entire farm.
    - For an example, see *Whole Farm Model.xls* which models the whole-farm economics for a 2,560 acre dryland farm, of which 640 acres are coming out of CRP. The model is from the perspective of a farm corporation operating entity, which cash leases the land it farms. To summarize the results of this model, the early transition period is economically challenging, but after Year 8, the farm transforms from being on the margins of survival (where it was prior to beginning the transition) to having realized substantial improvements in profitability that may make it economically viable in the long term.
        - In this example, all fields are certified after Year 10, with certification being implemented over a long period of time to reflect a conservative transition plan that *attempts* to increase organic acreage gradually, balance acreages of the crops in the rotation, balance income, and

avoid losses during the transition period. To demonstrate the challenge of balancing income and crop acreages when transitioning a farm, the acreages of fields (and crops selected for the fields) are not perfectly even or "matched".

- The model shows projections for a 20-year period to demonstrate the cyclical nature of net income that results in a situation in which the acreage balances between crops are not symmetrical and to simulate mid to long term economic performance.
- The example does not account for increases in organic yields over time or any changes in commodity prices or input costs.

Documentation of Original Estimates Entered in Assumptions Worksheet:

Many of the "default" estimates entered into the Assumptions Worksheet are "localized" for the region around Glasgow, in northeastern Montana. Users should adjust these estimates to reflect their own conditions, circumstances, and expectations of the future.

Source of Information for Conventional Crop Yields:

- The yields entered into the spreadsheet are derived from weighted average yields from Phillips, McCone, and Valley counties for an 11-year period (1997 – 2007) from a USDA National Agriculture Statistics Service (NASS) database (http://www.nass.usda.gov/Statistics_by_State/Montana/index.asp). The default assumptions presume that the spreadsheet user is developing rotations for dryland conditions, the most common practice of farming in the counties listed. To the extent possible, default yield data entered in the Assumptions is derived from non-irrigated production statistics, rather than from overall average county yields. For major cereal crops, NASS publishes more detailed county-wide statistics for non-irrigated acreages: non-irrigated fields *following summer fallow* and non-irrigated fields *under continuous crop management*. The Assumptions Worksheet utilizes this detailed information for cereal grain yield assumptions.
    - NASS did not publish yield data (or necessarily collect data) on every crop and related management practice for every county, every single year. This is a function of both farmers' planting decisions and NASS's statistics collection decisions and information disclosure policy.

Organic Crop Yields:

- It is anticipated that organic yields will be lower than conventional production yields due to the absence of supplemental fertilizer, absence of the benefit of synthetic herbicides for weed control, and lower moisture storage (relative to conventional no-till practices). The Assumptions Worksheet estimates organic crop yields based on multiplying conventional crop yields by "organic yield reduction factors". The yield reduction factors entered into the Assumptions Worksheet are based on Saskatchewan studies in the 1990's, as well as conservative estimates based on North Dakota research and reported yields in Montana.
- Some organic farmers state that, as a result of soil building management, organic yields increase with time after transition and may equal conventional yields *(with time)*,

particularly in moisture-limited areas. To allow this to be modeled, each Rotation Worksheet has a Yield Adjustment Factor to further adjust yields annually.

- During years identified as "transitional" in Organic Rotation Worksheets, the worksheets are designed to select organic crop yields.

Conventional Crop Prices:

- The crop prices entered into the spreadsheet are based on average crop prices from early Fall 2007 (August & September). At this time, commodity prices were elevated, but had not yet begun to increase to dramatic levels. Many forces are at work that will impact commodity prices: increased global demand for commodities *(for both food and energy),* increased international consumption of meat, persistence of stocks-to-use ratios that continue to be low compared to historical levels, global recession/depression, dynamic currency markets, and other global instabilities. For the future, a wide range of commodity prices are possible and volatility may continue. The Assumption Worksheet's prices can be changed to what the user believes to be appropriate for the time horizon under consideration.
- A variety of sources were used to develop Fall 2007 price estimates (USDA reports, Montana Wheat & Barley Committee data, market commentary in Agweek and Statpub.com, and Statistics Canada reports). The prices consider grain quality only to a limited extent: spring wheat (14% protein), winter wheat (ordinary grade), durum (U.S. No. 1 durum), and malt barley (malt-grade).
- The crop prices used are based on the most common price unit used in trading the commodity ($/bushel, $/lb, $/ton). Barley is traded in bushels and hundredweight, which causes confusion. The spreadsheet bases the barley price on $/bushel. To convert a $/hundredweight price to $/bushel (for barley), multiply the $/hundredweight price by 0.48. Commodity test weights are presented in the section of cost assumptions that pertains to seed cost (Row 25 in the Assumptions Worksheet).

Organic Crop Prices:

- The Assumptions Worksheet estimates organic crop prices based on multiplying conventional crop prices by "organic price factors". Organic growers and commodity buyers in Montana report that organic crop prices range from 150% to over 200% of conventional crop prices. In the Assumptions Worksheet, the "organic price factor" is set to 175% for most crops, except for certain specialty crops that may command higher prices.
    - Grain quality can have significant impact on organic prices, just like occurs with nonorganic commodities. The spreadsheet does not consider grain quality. For prices, organic grain quality is presumed to be equivalent to the nonorganic commodities being compared.
- During years identified as "transitional" in Organic Rotation Worksheets, the worksheets are designed to select conventional crop prices.
- Organic prices are not readily available in the public domain. For crops grown in Montana, organic prices are most readily available in the public domain for wheat. Farmers can contact a number of organic buyers in Montana for price quotes or production contract offers for a wide range of commodities.

    - At least one organic buyer in Montana has documented that since 2000, the organic wheat prices it offered have been less volatile than nonorganic wheat prices.
- To maximize the return on organic hay, growers will likely need to raise premium quality hay and market to out-of-state organic dairies, where prices exceeded $200/ton in 2007 and 2008 (*depending on hay quality*). Certain areas of Montana may be too remote to take advantage of organic hay markets.
    - The prices of organic alfalfa entered in the Assumptions Worksheet are the same as the conventional prices of alfalfa *(at the stack)*. The reason for this is that it is assumed that northeast Montana is too far from organic dairies to realize an economic benefit from selling alfalfa as an organic commodity, instead of selling hay locally to nonorganic buyers. This presumption has not been verified.

Conventional Seed, Herbicide, Fungicide, and Insecticide:

- The seed costs entered into the spreadsheet (on a $/acre basis) were derived using typical seeding rates and from calculated ratios (of seed price to crop price) from information presented in *Projected 2008 Crop Budgets North West North Dakota*, which was prepared by North Dakota State University Extension Service. www.ag.ndsu.edu/pubs/agecon/ecguides/nw2008.pdf
    - Users can (and should) adjust the conventional seed price and seeding rates to whatever they feel is appropriate.
- The costs entered into the spreadsheet (on a $/acre basis) for herbicide, fungicide and insecticide are derived from estimates made in Projected 2008 Crop Budgets North West North Dakota, prepared by North Dakota State University Extension Service. Similar current information is not published for Montana. It seems reasonable to use the cost projections for northwest North Dakota as a basis for direct costs in Montana because the estimates/projections are current, are made by qualified professionals, and are for similar farming practices and conditions as occur in Montana. These projections may be less reliable for farms that are distant from northwest North Dakota and have different growing conditions. On an individual farm, the cost of herbicides on a per-acre-basis can vary widely between fields depending on conditions and herbicide selection.
    - Except of safflower, fungicide costs for Montana crops are assumed to be zero, which is different than the northwest North Dakota projections.
- Spreadsheet input cells are provided for users to enter the number of chem fallow herbicide applications required and the chemical cost per acre of each application.

Organic Seed Cost:

- The Assumptions Worksheet estimates organic seed prices by multiplying conventional seed prices by the Organic Price Factor used in determining organic crop prices. The only exception to this is the price of alfalfa seed, which was estimated to be the same as conventional alfalfa seed.
    - Users can *(and should)* adjust organic seed prices to what they feel is appropriate.
- Spreadsheet users can also adjust the seeding rate for organic practices to be different than the conventional seeding rate.

    - The default organic seeding rates entered in the Assumptions Worksheet are the same as the conventional seeding rates. Increased seeding rates may be beneficial for organic crop production due to the absence of seed treat.
    - The default seeding rate entered for peas that get plowed down is the same as for peas planted for harvest of seed. It may be possible that reduced seeding rates can be used for peas that will be plowed down.
- Organic farmers are required to use organic seed unless the variety specified in the farm's organic system production plan is not available as organic seed. Organic growers often save seed. For these two reasons, the organic seed prices entered in the Assumptions Worksheet may be overestimated.

Organic Herbicide, Fungicide, and Insecticide Costs:
- Products exist (ladybugs, BT, vinegar, etc.) to perform some of these functions in compliance with federal organic rules. However, the default costs in the Assumptions Worksheet assume that these products will not be used. It is unknown whether these products are cost effective. If users believe such costs should be included and have estimates, the costs can be entered in the Assumptions Worksheet.

Conventional Crop Insurance
- Crop insurance costs entered into the spreadsheet are based on 2008 weighted average premiums per acre for APH policies for Phillips, McCone, and Valley counties. The source of this is publically available from USDA Risk Management Agency (http://www3.rma.usda.gov/apps/sob/stateCountyCrop.cfm **)**.
    - In some counties in Montana, it may not be possible to insure all of the crops listed in the spreadsheet. Spreadsheet users can contact their crop insurance agent or enter cost estimates ($/acre) they believe to be appropriate for their production history and desired level of coverage.
    - The default crop insurance cost does not include hail insurance. For 2008, hail insurance premiums for dryland were $4.50/acre for McCone County; $4.00/acre for Phillips County; and $3.50/acre for Valley County.
- The spreadsheet does not provide a means to model the revenue that crop insurance provides when a loss occurs. Because of this, the spreadsheet reflects an implied assumption that a loss of crop revenue will be equally offset by insurance revenue. In reality, crop insurance does not provide complete coverage for losses of crop revenue.

Organic Crop Insurance Costs:
- The spreadsheet assumes that organic crop insurance premiums are 5% higher than conventional crop insurance premiums for the same crop, which is likely incorrect. Spreadsheet users should develop cost estimates with the assistance of their crop insurance agent to accurately determine the price. Spreadsheet users can enter cost estimates ($/acre) that they believe to be appropriate for organic crops.
- It is difficult to achieve an apples-to-apples comparison of crop insurance policies between organic and nonorganic crops. Due to lower yields and the insured price being set at nonorganic crop price levels, the premiums for crop insurance on organic crops may be lower than for conventional crops, even with the 5% surcharge currently being applied to organic crop insurance policies.

- Currently, the degree of revenue protection provided for organic crops by multiperil crop insurance is inferior to what is available for nonorganic crops. An equivalent yield deficiency would result in a greater loss of revenue for an organic crop.
- The 2008 Farm Bill instructs the USDA Risk Management Agency to develop improvements for crop insurance policies for producers and review the necessity of the 5% surcharge currently placed on organic policies. If new policies establish insured prices at organic price levels, premiums will increase from current levels, but will offer greater income protection.

Conventional Fertilizer Costs:

- Nutrient uptake of nitrogen, phosphorus, potassium, and sulfur was calculated for each crop based on the nine and ten-year average yields based on *Fertilizer Guidelines for Montana Crops*, published by the Montana State University Extension Service in 2005.
- The fertilizer application rate is calculated by multiplying the nutrient uptake at expected yields by a "yield target percentage".
    - The default fertilizer costs are based on a yield target percentage of 130%.
    - Spreadsheet users can adjust the yield goal percentage. A fertilizer rate based on a yield goal percentage of 100% theoretically will replace the nutrients removed when the yield of harvested grain is equal to the estimated average yield.
- In the Assumptions Worksheet, the default cost of individual fertilizer components ($/lb of nutrient) for Nitrogen, Phosphorus, Potassium, and Sulfur are based on Spring 2008 fertilizer prices reported by the Montana Department of Agriculture Fertilizer Program. Compared to Spring 2008, prices for Fall 2007 were about $0.10 - $0.15/lb lower for Nitrogen and Phosphorus. Because of trend for increasing global energy consumption, wide concern over greenhouse gas emissions, and the perception that natural gas is a "clean" fossil fuel, it seems reasonable to assume that demand for natural gas will remain strong, which will likely prevent nitrogen fertilizer prices from decreasing in the mid-term to long-term time horizons.
- Nitrogen fertilizer requirements (and cost) for crops following alfalfa and pulse crops theoretically will be lower. The spreadsheet takes nitrogen fixing into account by reducing the direct cost of growing alfalfa and pulse crops by the estimated value of the fixed nitrogen. While any actual cost reduction occurs after pulse crop or alfalfa production, it seems appropriate to attribute the economic benefit to the pulse crops or alfalfa.
    - Nitrogen credits are estimated for raising pulse crops for grain (10 lbs N/acre), for pulse plowdown crops (20 lbs N/acre), and for alfalfa (100 lbs N/acre).
    - The calculated value of the fixed nitrogen is based on the estimated nitrogen credits and the estimate of the cost of nitrogen fertilizer used to in conventional fertilizer calculations.

Organic Fertilizer Costs:

- Organic fertilizer products exist (such as rock phosphate) that are in compliance with federal organic rules. Manure can also be applied. This spreadsheet assumes that these products are not cost effective (*or will be free - in the case of manure*). If users believe such costs should be included and have estimates, the costs can be entered in the Assumptions Worksheet.

Fuel & Lubrication Costs:

- Direct fuel cost estimates are based on the fuel consumption of field operations selected for each crop/year multiplied by the estimated dyed diesel price. The field operations for each crop/year are selected in the Organic Rotation and Conventional Rotation Worksheets.
  - The source of information for fuel consumption of individual field operations is a study published by the Colorado State University Extension Service in 2007, titled *Estimating Farm Fuel Requirements* (http://www.ext.colostate.edu/PUBS/FARMMGT/05006.html). Users can change fuel consumption rates to match their experience.
  - Estimates were made for the fuel consumption of the following field operations: broadcasting seed or fertilizer, rolling, and canola kinking.
- Fuel costs are based on dyed diesel only, using an approximate cost from mid-October 2008. While prices have plummeted since, over the long-term, the default price may actually be low.
- Lubrication costs are estimated to be 15% of fuel costs. This is a percentage used in several other farm production economic analyses. Spreadsheet users can the change lubrication cost estimate factor.

Off-Farm Trucking to Market:

- The cost of off-farm trucking to market is based on an estimated trucking rate ($/loaded mile), weight of crop to be hauled from the farm to market (per acre of production), weight of commodity that can be hauled in a semi trailer (lbs/load), and estimated distance from farm to market.
  - The weight of crop to be hauled (per acre) is based on the conventional and organic yields used to calculate revenue.
  - The weight of the grain that can be hauled in a semi trailer with a pup trailer is presumed to be 69,000 lbs, except for safflower (43,700 lbs – due to a lighter test weight than the other crops). For single trailers, the load may weigh approximately 48,000 lbs, except for safflower (30,400 lbs).
  - The default load for alfalfa is set to 40,000 lbs/load for local hauls on a semi trailer. For long-distance hauls on double trailers, the load may weigh 60,000 lbs. These load estimates are for square bales.
  - The Assumptions Worksheet allows users to enter different distances to market for each crop and different distances for conventional and organic commodities. Spreadsheet users should update the assumptions to the situation for their operation. Actual distances to market will depend on the proximity of the farm operation to grain buyers of a given commodity.
    - The assumption used in the spreadsheet is that off-farm trucking for conventional commodities will be to local buyers and that off-farm trucking for organic commodities will to the Great Falls region.
    - It is assumed that northeast Montana is too far from organic dairies to realize a benefit from selling alfalfa as an organic commodity and therefore will be sold at the stack as conventional hay. This should be

adjusted to match organic hay marketing assumptions being made by the user.

- The cost of off-farm trucking is also calculated in units of $/bushel and $/ton.
- With fuel and trucking costs in flux, spreadsheet users should adjust the cost per loaded mile estimate to reflect their own projections for future trucking costs. Backhauls may provide an opportunity to reduce trucking costs.

Operating Interest

- Operating interest is calculated based on the sum of all other direct costs multiplied by an annual interest rate and divided by the fraction of a year that interest accrues.
    - The original estimates use an APR of 8.5%, with interest accruing for nine months. Spreadsheet users should adjust the APR and months of accruing interest to reflect actual conditions for the operation.
    - If an operation is in a strong cash position and does not use operating loans, the APR should be adjusted to match the interest rate the operation receives from farm savings accounts that are used to finance operations. In this situation, the number of months of accruing interest should match the operating cycle (average period from expenditure of operating cash to receiving cash from sale of crop commodities).

Net Present Value Discount Rate

- For each rotation, the spreadsheet calculates the net present value of the annual return after direct costs for the first three years and for the first four years. These measures utilize the concept of the "time value of money" (interest) in the evaluation of economic performance of short periods of time during which the organic transition occurs.
    - The default net present value discount rate is set at 8.5%, which reflects a discount rate that is similar to the rate of interest for operating loans.
    - In situations where the farm operation is in a strong cash position, it may be appropriate to use a lower discount rate that reflects the interest rates the operation receives from savings accounts used to finances operations.
    - In situations where the farm owners have access to investment opportunities that offer greater returns on investment, it may be appropriate to use a higher discount rate to match the rate of return available from the alternative investments.

Field Operations Time/Labor Requirements

- The Organic Rotations and Conventional Rotations Worksheets calculate the total hours of field operations (direct labor requirements) per acre for each crop/year in the rotation. The calculations depend on the field operations selected for each crop/year in the Organic Rotation and Conventional Rotation Worksheets and on equipment productivity information entered into the Assumptions Worksheet.
    - In the Assumptions Worksheet, the required hours per acre for each field operation is calculated based on the implement width, operating speed, and operating efficiency. The Assumptions Worksheet also calculates the acres/hr productivity rate for each field operation.
    - The operating speeds and efficiencies used in the initial assumptions are based on information provided in the *Enterprise Crop Budget Generator* spreadsheet

created by Duane Griffith of the Montana State University Extension Service. (http://www.montana.edu/wwwextec/software/enterprisebudgetor.xls)

    - Spreadsheet users can (and should) adjust implement operating width, speed, and operating efficiency to match the farm operation being analyzed.

- Spreadsheet users can use the field operations calculations to evaluate time requirements for different rotations and production systems. These calculations may lead users to consider equipment needs, the possible need to utilize custom farming services, and consider the timing and synchronization of field operations. In appropriate situations, the calculations can potentially be used to compare direct labor costs between alternatives.

Discussion on Approach of Economic Comparison: *Return After Direct Costs (Per Acre)*:
The following paragraphs explain concepts that are the basis for the design of the spreadsheet.

Ultimately the spreadsheet compares the Return After Direct Costs per acre in a comparison that is limited to relevant costs and relevant revenues of different crops, rotations, and farming practices. This approach makes comparisons based on the differences between the alternatives (relevant costs and relevant revenues) and ignores costs and revenues that are the same, regardless of the alternatives.

With its focus on Returns After Direct Costs Per Acre, it is hoped that the spreadsheet will be a user-friendly tool that can produce comparable analyses for a wide range of users. There can be great variation of indirect and fixed costs between farm operations due to differences in farm size, ownership of farmland and equipment (owned or rented), stage of land and equipment debt repayment, age of equipment, equipment replacement strategies, and labor costs, which can be dependent upon the cost of the lifestyles maintained by farm owner-operators.

Relevant comparisons can ignore fixed costs, so long as fixed costs remain the same for the alternatives being compared. In the overall farm cost structure, indirect costs tend to be fixed costs. For the individual farm, these costs do not vary with the number of acres farmed, unless major expansion or contraction occurs. Fixed costs do not vary with the alternatives being considered by the spreadsheet: crop/rotation selection and farming system (conventional vs. organic). Therefore, within the constraints identified, fixed costs are not relevant to the comparison of alternatives.

Including land cost in the comparison can create problems for comparability because of the differences between cash rent, crop share rent, and the "cost" of owned land. The land cost of rented land is a direct cost, whereas the "cost" of owned land is not a direct cost. Land cost for fields rented on a crop share basis will likely vary between alternatives because the cost is based on crop revenue and shared fertilizer cost, which will vary between crops. Other relevant differences could arise if the landlord in a crop share rental arrangement places different limitations on the crop selection and rotation decision for the given farming system (organic or conventional) or agrees to a different crop share rental equation for organic production. In terms of relevancy for comparison purposes, the cost of cash-leased land and owned land should not be relevant because the costs should not vary between the alternatives.

Direct revenue varies between crop types because of the differences in crops' yield and market price. For a given crop, direct costs should not vary greatly <u>on a per acre basis</u>, if best practices are followed and prudent judgment is used. Direct costs will likely differ between crop types.

In traditional accounting and economics terminology, the term "variable costs" includes costs that this guide and the spreadsheet refer to as direct costs. The terminology for "variable costs" was originally derived to describe costs in a manufacturing setting. Variable costs are costs (such as the cost of raw materials) which vary with the quantity of products being manufactured. The quantity of production, and therefore variable costs, are within the manufacturer's control. Unlike manufacturers that try to match production with market demand, farms seek to maximize production at the field level to the point of diminishing returns. The quantity of what is harvested on a farm (its production) tends to be much more dependent upon weather than the farm's investment in inputs (direct costs), which impact yield to varying degrees. As such, in the farm setting, what <u>drives</u> "variable costs" is not the quantity of commodity harvested, which is largely beyond the farm's control, but rather the number of acres of given crops planted, for which the farm has total control. This is an important difference from the relationship between variable costs and production levels that exists in manufacturing settings. Under the approach used in the spreadsheet, the presumption is that available acreage for a farm is fixed, with the variable factors being crop selection, rotation sequence, and method of crop management (organic vs. conventional).

Determination of Return After Direct Costs Per Acre is not a calculation of a total economic return. The calculation of total economic returns is not necessary for comparing alternatives in a short-term to mid-term time horizon. Total economic returns are important for evaluating the economic viability of a farm operation and for making strategic investment or liquidation decisions.

Comparison of the Returns After Direct Costs Per Acre examines alternatives for which <u>operational decisions</u> for change can be made. This analysis focuses on operational decisions (crop rotations, organic vs. conventional) with the assumption that this is the primary decision area for the individual farm. A major assumption for this approach is that the individual farm will not be making major changes to its fixed cost structure in the short-term to mid-term. Fixed costs generally change as the result of investment and hiring decisions. Equipment purchases or increasing hired labor to enable acreage expansion are examples of changes in fixed cost structure for farm operations. The assumption that the individual farm will not be making major changes to its fixed cost structure is reasonable in an environment where the availability of additional cropland is low and where the probability of securing additional available land is low (for many farm operations). Retirement of Montana's aging farm operators is a factor that could increase land availability. However, it is unclear whether the situation of intense competition for land will change – even as Montana's farm operators age. Montana is not shielded from outside influences such as farm consolidation driven by technology and declining commodity margins, land speculation, and trophy farm/ranch ownership.

Return After Direct Costs Per Acre ***for a given crop*** should not vary greatly between farm operations, assuming that best practices are followed and prudent judgment is used. More variation is likely to exist between farm operations' fixed costs. Both elements of cost involve strategic decisions. The strategic decisions developed around analysis of Return After Direct Costs seek economic advantage through crop rotation selection (diversification, rotational benefits, niche opportunities). The strategic decisions affecting indirect and fixed costs are focused on achieving economic advantages through efficient use of capital investment and variations in the configuration of capital investment. Both kinds of strategic considerations are important.

Comparison of Rotations Instead of Individual Crops

To achieve comparability, the economic performance of different rotations and systems must be calculated on an average annual return basis. Evaluating rotations also acknowledges that there are constraints to sequences of crops. Rotations also provide production and market risk diversification. Organic farming systems require the use of rotations of a variety of crops for integrated pest management, soil fertility and building, and moisture management. Even the most simple conventional crop systems in Montana involve the use of a rotation (crop-fallow) for moisture management. Conventional farming operations not considering a transition to organic production can use the spreadsheet to compare traditional conventional rotations (such as wheat-fallow) with rotations designed to achieve higher levels of integrated pest management, economic diversification, and fertilizer cost reduction through nitrogen fixing.

Key concepts / Assumptions

- *Return After Direct Costs as the appropriate measure for comparison:*
    - Crop Revenue – Direct costs = Return After Direct Costs
        - Examples of direct costs include seed, fertilizer, herbicides, insecticides, crop insurance, fuel and lubrication, trucking to market, and related operating interest.
        - Cash rent is a direct cost that is a fixed cost, as is the "cost" of owned land. Crop share rent is a direct cost that varies with yield, crop prices, and fertilizer cost share. In the default rotations, it is assumed that land cost does not vary with the alternative, or is "sunk" and therefore is not relevant to comparing alternatives.
            - The spreadsheet allows land rent to be manually entered as a direct cost for each crop/year in each rotation. It would be appropriate to include this in the analysis if the land rent varies between the crop grown or the method of crop management (organic vs. conventional). A difference in land rent cost between alternatives will likely exist if land is rented on a crop share basis.
    - Fixed costs are not relevant for comparison because these costs do not vary with the rotation alternatives. Fixed costs tend to be indirect. Although they could be allocated to crops within a rotation, the cost in total would not change.
        - Examples of fixed costs include equipment depreciation, professional services, and in many situations, labor.
    - This approach is appropriate for comparing the economic performance for the short-term to mid-term time horizon.
- *The individual farm using the spreadsheet is operating within a relevant range of capacity*: Equipment and labor costs tend to be fixed for a relevant range of acreage,

until expansion creates a constraint that must be overcome through addition of capacity (through equipment or labor). The approach of using return after direct costs remains valid even if acreage increases (within the relevant range of existing capacity) because fixed costs and indirect costs remain constant.

  - The farm is adequately equipped and does not need to hire additional labor to grow any of the crops being considered.
  - If the situation exists where the cost structure of a farm has labor costs that are identifiable as direct costs and where the direct labor cost varies with the individual crop, the spreadsheet allows users to manually enter those costs on a per-acre basis for each crop/year in each rotation. Similarly, if the farm has custom hire costs or machine rental costs that are identifiable as direct costs and vary with the individual crop, the spreadsheet allows those costs to be entered for each crop/year in each rotation.

- *The individual farm using the spreadsheet is a going concern*: The farm is economically viable so that it is capable of staying in business and its owners are committed to continued operations. If there is any question, a total economic return should be calculated to determining whether the farm operation is a going concern.
- *Sunk costs*: Costs incurred for past decisions "are sunk" and should not have undue influence future decisions. What is done is done; planning for the future should focus on what provides the best returns in the future. Many indirect costs or fixed costs are sunk costs.
- *Assumption that government payments are not significantly different between options:* Government payments are omitted from this analysis since government payments: are not part of the value creation process; tend to be somewhat fixed regardless of planting decision (with exception of LDP payments); and are becoming increasingly insignificant at current market and target prices (with the exception of disaster payments). At the present time, it is not clear what role government payments will play (if any) in the comparative economics of different crops, rotations, or farming systems.
  - In the short term, the 2008 Farm Bill provides for EQIP funding to assist farms with converting to organic production. Potentially, a farm will be able to receive up to $20,000 per year, with organic conversion assistance not to exceed $80,000 over a six year period. Contact your local USDA Farm Service Agency office to learn more about eligibility requirements, available funding, and determination of payment amounts. The 2008 Farm Bill also provides for cost share payments of up to $750 for organic certification and calls for streamlining coordination between the Conservation Security Program and the National Organic Program.
- *Because crop insurance revenue is not considered, it is assumed that crop insurance proceeds equal the value of the crop loss.* In reality, because crop insurance only provides a certain percentage of coverage, crop insurance settlements do not replace the full amount of income lost by impaired yields. Currently, crop insurance policies for organic crops provide a price guarantee that is tied to nonorganic crop prices. As a result, crop insurance policies for organic crops provide lesser *degree* of revenue protection than is available for nonorganic crops. The spreadsheet does not account for this potentially significant difference. Spreadsheet users should take this under consideration.
  - The 2008 Farm Bill instructs the USDA Risk Management Agency to develop improvements for crop insurance policies for producers and review the necessity

of the 5% surcharge currently placed on organic policies. If new policies establish insured prices at organic price levels, premiums will increase from current levels, but will offer greater income protection.

- *Lack of consideration for the variability of numerous factors: yields, commodity prices, direct costs.* The spreadsheet models the economic performance of crop rotations and methods of production (organic vs. conventional) with single-value assumptions. The default values entered into the Assumptions Worksheet are based on long term averages, information for given points in time, standard commodity quality, and rough estimates for the future that are applied throughout the time horizon being considered. In reality, the numbers entered for each assumption have a range of possible values with different probabilities of occurrence. Variables (such as yield) have different coefficients of variability for different crops and different methods of production (organic vs. conventional). Organic wheat yields may *(or may not)* have a wider range of possible yields than conventional wheat. For a given crop, if organic yields have a greater coefficient of variability than conventional yields, then the spreadsheet's calculated returns for that crop in organic rotations will have a higher risk of error than for calculated returns for that crop in conventional rotations.
    - An ideal economic model would account for variability and probability and be supported by perfect information specific to the farm being analyzed. The ideal economic model would assess risk or the impact of variability on calculated economic outcomes. Incorporating mechanisms to account for variability into the spreadsheet could add considerable complexity to the spreadsheet design, make the spreadsheet less user-friendly, and interfere with the objective of making the spreadsheet highly flexible. The spreadsheet's current design provides latitude to users to use their own judgment in developing farm-specific assumptions. It is unclear whether sufficient information is available to analyze variability on a state-wide scale, let alone *(and more importantly)* at a localized level that would be applicable to an individual farm.
    - An ideal economic model would not limited the consideration of variability to commodity yields and prices, which would need to be considered separately for different farming systems and markets (organic vs. conventional). In addition to commodity yield and price, an ideal economic model would consider the variability of significant direct costs in the comparison of alternatives.
    - The spreadsheet is meant to be used as a first step in the consideration of alternatives in crop rotation and farming system (organic vs. conventional). Farmers constantly face changing conditions that affect numerous variables and have to reach decisions without complete information. Ultimately, farmers must utilize available information, observation, and personal experience to perform their own personal calculus (that considers risk and variability) to reach decisions. Experience, risk tolerance, economic situation, growing conditions, and the individual farm's agricultural capacity vary - which is why different farms adopt different farming strategies.
    - It is expected that most farmers require new alternatives to provide economic returns that exceed the status quo before making changes. It is assumed that in determining the minimum amount of "premium" required to stimulate change, the individual farmer applies "personal calculus" that accounts for variability and

risk. In other words, each individual farmer considers the following questions: To what degree do I believe the numbers calculated? How likely is the projected outcome? How much more effort will the alternative require? How will the alternative affect the rest of the operation? If the alternative does not turn out, how much worse off will the farm be than if it stayed with the status quo? Considering everything, is the potential economic benefit high enough to take on the risk?

    - One way for spreadsheet users to examine the impact of variability is to make multiple models that show best case estimates, worst case estimates, and average/expected case estimates for the most significant variables (such as commodity price, yield, fertilizer cost, herbicide cost, and trucking cost). Making multiple models will not address the probability of outcomes, but will help estimate the potential range of outcomes.
    - More information on the role of variability of organic crop prices and direct costs on the economic performance of organic agriculture may be available in the future. The 2008 Farm Bill established $5 million of mandatory funding for collection and analysis of economic information for organic agriculture, with authority for additional appropriations up to $5 million per year. In contrast, the 2002 Farm bill did not provide any mandatory funding for economic analysis of organic agriculture.

- *The spreadsheet does not allow users to vary the prices of commodities or direct costs with time.* This limitation simplifies the spreadsheet design and improves ease of use, but requires that spreadsheet users enter what they believe will be representative prices for the timeframe under consideration. Spreadsheet users should consider this limitation in their personal calculus of variability and risk.
    - It is presumptuous to consider the default values of prices and input costs entered into the spreadsheet to be representative of future prices and costs. It would seem equally presumptuous to attempt to predict future prices of commodities and direct costs on a year-by-year basis. As witnessed in 2007 and 2008, even expert industry analysts can be significantly off in predicting prices of commodities and direct costs.
        - The duration and impact of the current recession on commodity prices and direct costs in the short-term and mid-term is unknown. Numerous trends will affect commodity prices, direct costs and agricultural practices in the future, for both conventional and organic agriculture. Examples of these trends include: population growth, improved global standard of living, increased integration of global economies, leaner inventory management that is more susceptible to supply shortages *(and depresses prices when surpluses occur)*, increased global energy consumption, declining global oil and gas reserves, increased economic and humanitarian impact of catastrophic weather events, observed changes in the global climate that may point to changing weather patterns, potential for greenhouse gas markets and regulations to impact agriculture, increasing intensity and sophistication of agriculture in second and third world nations, declining rates of reproduction in first world countries, demographic bubbles, increased concern over food safety and nutrition, advances in

biotechnology and other agricultural technologies, corporate determination to promulgate biotechnology, loss of agricultural land to nonagricultural use, conflict over natural resources, and weakening in the United States' position as the world economic leader.

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